MARKET 20 — HOMEOWNER CENTRAL AIR CONDITIONER PURCHASE MARKET

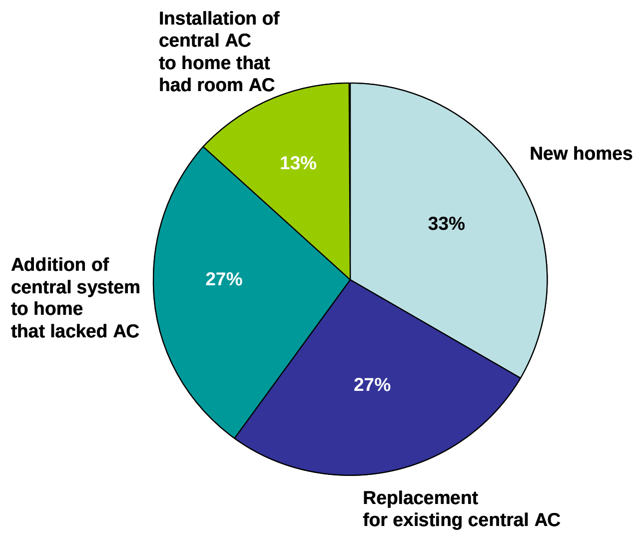
Market Scope

This market comprises purchases of new central air conditioners by residential homeowners. The market includes replacement purchases, households adding central air conditioning to an existing home, as well as purchases for new homes.

Market Characteristics

Well over half of Wisconsin homes have central air conditioning— a figure that grows each year as central air is added to existing homes, and new homes (nearly all of which have central air conditioning) are built (Figure 1). All told, we estimate that between 70,000 and 80,000 central air conditioners are installed in Wisconsin single-family homes each year. Data from the Energy Center's biennial Appliance Sales Tracking surveys suggest that about half of central air conditioner sales are also associated with the purchase of a new furnace.

FIGURE 1, THE WISCONSIN CENTRAL AIR CONDITIONER MARKET.



Source: ECW Appliance Sales Tracking Survey

With respect to efficiency levels, the most important news is that starting in 2006 (Year 1 of our analysis), new federal standards will require all new units manufactured to have a minimum SEER rating of 13—up three points from the current standard of SEER 10. Since only about 10 percent of the Wisconsin market currently meets or exceeds the new standard, this will significantly increase the efficiency of central air conditioners installed in the state.

With the most efficient air conditioner models now at SEER 20, there is still room to stimulate markets for more efficient units. However, for Wisconsin's relatively short cooling season, the payback for upgrading beyond SEER 13 is not particularly attractive. For example, the electricity savings on a typical 2.5 ton unit that is operated 400 hours per year amounts to only about $12 per year for upgrading from SEER 13 to SEER 15, an upgrade that would likely cost at least several hundred dollars.

As part of the rule-making process that led to the SEER-13 standard, the federal government considered a number of possible scenarios for what the distribution of efficiency levels would look like (at a national level) after implementation of a new standard. On the optimistic side, the distribution of efficiency levels in the market could simply shift to a higher baseline, resulting in a significant increase in sales of higher efficiency equipment. On the pessimistic side, sales of current equipment below the new standard could simply "roll-up" to the new standard with no effect on higher efficiency unit sales. The most pessimistic scenario considered was a “collapse” scenario in which the new standard actually draws down sales of higher efficiency units.

For the SEER-13 standard that was eventually implemented, the analysis concluded that on the basis of consumer paybacks and likely changes in prices, even a “roll-up” scenario would be optimistic for current technology, implying a real possibility that sales of higher efficiency equipment will decline in the future as competition reduces prices at the SEER-13 level. Though noting that the pace of technological development in the air conditioning market has declined since the 1990s, the analysis did leave open the possibility, however, that emerging technology could reduce the cost increment between SEER-13 and higher efficiency equipment, creating upgrade cost effectiveness comparable to the market under the current SEER-10 standard.

All of the preceding analysis is premised on the notion that consumers are primarily motivated by payback (or at least absolute energy cost savings) in their choice of efficiency level. Yet it is not implausible that at least some consumers are less motivated by payback and simply want high end equipment. Moreover, two-stage air conditioners have begun to make limited headway in the Wisconsin market; these are marketed as providing comfort features that consumers may find attractive regardless of the energy economics. These aspects of the market also create the possibility of at least a niche for equipment sales beyond the new standard.

Some argue that installation practices have as much—or more—influence on actual field performance of central air conditioners than the rated efficiency level. To operate at peak efficiency, units must have the correct refrigerant charge and airflow over the indoor evaporator coil. Too much or too little of either leads to reduced operating efficiency. Research in other parts of the country (and limited data from Wisconsin) suggests that optimal installations are more the exception than the rule, with typical savings on the order of 10 to 20 percent from correcting installation defects. At the same time, central air conditioners that use a device called a thermostatic expansion valve (TXV) are less susceptible to performance problems related to refrigerant charge and airflow—and the use of TXVs may become more prevalent under the new efficiency standards.

Program Approaches

We consider here an incentive program to promote systems with rated efficiencies higher than the upcoming SEER-13 standard. We have also considered achievable potential from improving central air conditioner installation and maintenance practices: these efforts are consolidated under the separate cross-cutting market area for residential HVAC installation and maintenance practices (Market 37x).

PROGRAM AREA 20.01 — INCENTIVES FOR HIGH EFFICIENCY CENTRAL AIR CONDITIONERS

This program area is oriented toward encouraging central air conditioner upgrades beyond SEER 13, which would probably be in the range of SEER 14 or SEER 15. Since the market has not yet transitioned to the new federal standard, it is difficult to predict what the market response would be to such a program offering; we have therefore modeled higher uncertainties for this program.

Table 1, Midpoint estimates of program costs and achievable impacts for program area 20.01 — Incentives for high efficiency central air conditioners.

Year	Program Costs ($000s)	Incremental First-Year Impacts		
		Peak kW	Annual kWh (000s)	Annual therms (000s)
1	$203	113	48	0
2	$216	141	60	0
3	$232	176	75	0
4	$253	220	93	0
5	$278	276	117	0
6	$278	276	117	0
7	$278	276	117	0
8	$278	276	117	0
9	$278	276	117	0
10	$278	276	117	0

(TECHNICAL DOCUMENTATION)

Program Area 20.01 — Incentives for central air conditioner efficiency upgrade

Model inputs for this program area are summarized in the table below, and described on the following pages.

Model Inputs (20.01)			**Value**	**±**
1		**Per-Unit Impacts (unit = one central air conditioner)**		
	a	std. unit SEER	13.0	0.0
	b	upgrade unit SEER	14.5	0.5
	c	field performance factor	1.0	0.15
	d	Mean cooling capacity of unit (tons)	2.5	0.25
	e	Mean annual hours of operation	400	100
	f	estimated SEER - EER difference	1.5	0.25
	g	Diversified demand factor	0.75	0.10
2		**Program Participation**		
	a	Participants in Year 1	500	400
	b	compounded annual growth in participation (Years 2-5)	25%	20%
	c	net-to-gross ratio	1.0	0.5
3		**Program costs**		
	b	Fixed program costs	$150,000	$50,000
	c	Variable costs per-participant (incentive, and admin.)	$105	$25
4		**Measure life (years)**		
	b	Measure life (years)	20	4

1. Per Unit Impacts

We assume that the typical upgrade under the program would be from the federal standard SEER 13 ***(Input 1a)*** to either SEER 14 or SEER 15 ***(Input 1b)***, which results in a mid-point estimate of about a 10 percent efficiency improvement. There is some uncertainty as to the extent to which the SEER rating procedure captures the average field efficiency of a central air conditioner installed in Wisconsin (James J. Hirsch and Associates, 2004). We therefore built in a ± 15 percent performance uncertainty factor into the estimates as well ***(Input 1c)***. This factor essentially allows for the actual field SEER for both the standard and upgrade systems to differ by up to two SEER points on either side of the mid-point estimate (e.g. SEER 11 or SEER 15 instead of SEER 13).

We assume that the typical central system has a cooling capacity of about 2.5 tons (30,000 Btu per hour), as reflected in the data from the Energy Center's 1999 Energy and Housing study (Pigg and Nevius, 2000) ***(Input 1d)***.

We found little public data on the hours of operation for central air conditioners in Wisconsin. Maps of cooling load hours for the United States available from several public sources (Iowa Association for Energy Efficiency, n.d.; Louisiana Energy & Environmental Resource & Information Center (n.d.); and USGPO, n.d.) suggest between 400 and 600 hours of operation for a typical Madison-area central air conditioner (Madison is close to the population-weighted average weather for the state). However, data from 26 southern Wisconsin homes monitored as part of the Energy Center's field study of electricity use in new furnaces (Pigg, 2003) showed a range in weather normalized annual hours of operation from about 100 to 800 hours per year, with an average of about 350 hours per year. For the purposes here, we have taken 400 ± 100 hours as the typical operating hours for a Wisconsin central air conditioner ***(Input 1e)***.

Estimating peak demand impacts requires assumptions about the efficiency of the systems under peak conditions (since air conditioner efficiency is strongly related to outdoor temperature) as well as estimating the degree to which the population of central air conditioners is in use at the time of system peak.

The energy efficiency ratio (EER) is the standard measure of system efficiency at the high outdoor temperatures that typify summer peak utility system demand. EER is similar to SEER in terms of measuring the ratio of Btu/hr of cooling capacity to input electrical energy. But EER is based on a 95^{o}F outdoor temperature, while SEER is based on 82^{o}F outdoor conditions. The technical analysis conducted as part of the rulemaking for the SEER-13 standard provided data showing that the EER of SEER-13 split air conditioners mostly ranged between 11.0 and 12.0, with a median of 11.6 (USDOE, 2002). We have therefore assumed (for both standard and high efficiency units) that on average EER is 1.5 ± 0.25 lower than SEER ***(Input 1f)***.

In terms of system operation at time of utility peak, we assume a diversified peak demand factor of 0.75 ± 0.10, representing the average fraction of full system output at system peak ***(Input 1g)***. This factor reflects both the likelihood that not all air conditioners will be operating during system peak as well as the duty cycle of those that are operating. We have derived this estimate from unpublished data from the Energy Center's 2003 Appliance Sales Tracking survey that asked respondents about how they had operated their air conditioner in the previous 24 hours. These data suggest that about 70 to 80 percent of households will be operating their air conditioner on a hot weekday afternoon with the temperature above 90^{o}F.

2. Program Participation

Participation in this program is difficult to predict given the uncertainties in the market from the new federal standard. On the one hand, what is now considered to be an unusually efficient air conditioner will become the norm, seemingly leaving little incentive for households to upgrade to higher efficiency levels—especially if the upgrade cost is considerable, as suggested by the technical analysis conducted as part of the rulemaking for the SEER-13 standard (USDOE, 2002). On the other hand, it is not implausible that some consumers would continue to be receptive to marketing on the basis of higher efficiency relative to the new baseline, and that two-stage equipment will have attractions that go beyond the operating cost economics.

Focus on Energy provided incentives for about 1,000 SEER 14+ air conditioners in the last two quarters of 2004, which typically account for 40-50 percent of annual sales, according to tracking data from the Energy Center's Furnace and AC Tracking System (FACTS). However, the current rebate for SEER 14+

units under Focus on Energy is $300, a level that would be difficult to cost justify programmatically when the assumed upgrade is from SEER 13 rather than SEER 10. We have therefore assumed 500 ± 400 participants in Year 1 of the analysis ***(Input 2a)***. We also assume a compounded annual growth rate in the number of participants of 25 ± 20 percent per year between Years 2 and 5 of the analysis ***(Input 2b)***. The combination of these two inputs results in a mid-point estimate of about 1,300 participants per year in Year 5, but with a (90% confidence band) that spans from about 300 to 3,000 participants, reflecting the considerable uncertainty in the market response to the program.

The program net-to-gross ratio (reflecting the combined impact of free riders and program spillover to non participants) is also fairly uncertain. On the one hand, it is plausible that a significant proportion of program participants might be households that would have purchased a high efficiency unit regardless of the incentives. On the other hand, it is also possible that incentives might stimulate the market for two-stage units that have additional comfort benefits. We assume a net-to-gross ratio of 1.0 ± 0.5 to attempt to bridge these possibilities ***(Input 2c)***.

3. Program Costs

We have assumed a fixed program administration cost of one FTE ($100,000), plus $50,000 per year of additional marketing and other costs ***(Input 3a)***. We also assume an upgrade incentive of approximately $100—large enough to attract attention, but considerably less than the current incentive. We also added a $5 per unit variable processing cost, for an overall variable program cost per unit of $105 ± $25 ***(Input 3b)***.

4. Measure Life

We assume a central air conditioner life of approximately 20 ± 4 years ***(Input 4a)***. This figure is reasonably consistent with values used in the technical analysis conducted for the rulemaking process that led to the SEER-13 standard (USDOE, 2002).

References

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